



# **NASA's ARSET Program: Building Capacity to Utilize Aura data for Air Quality Applications**

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**NASA Goddard Space Flight Center  
GESTAR/USRA/JCET/UMBC**

**EOS Aura Science Team Meeting, September 15-18, 2014**  
**10th year anniversary celebration!**

National and international activities to engage and train users applying NASA Earth Science satellites and modeling data in their decision making activities



## NASA Satellite Images Will Help Farmers Conserve Water

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By VINNIE TONG

Listen 3:35



The image shows a vast, healthy green alfalfa field under a clear sky. In the immediate foreground, a large, white, cylindrical irrigation pipe runs horizontally across the frame. Two sections of the pipe are broken or cut, and clear water is gushing out from these openings, creating white foam and splashing onto the green plants. A small orange object, possibly a tool or marker, lies on the ground near the left pipe opening. In the background, a line of trees and some distant structures are visible on the horizon.

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By VINNEE TONG

 **Listen**

3:35

Flood irrigation in a Los Banos alfalfa field.  
*Vincent Tang*

# NASA Applied Science : Capacity Building Program



## Applied Remote SEnsing Training, ARSET (GSFC)

On-line and hands on basic/advanced trainings tailored to end-uses organizations

## **DEVELOP (LaRC national office)**

Dual student/local government capacity building using collaborative projects

## **SERVIR Coordination Office (MSFC)**

Building international capacity with hubs in

- East Africa
- Hindu Kush - Himalaya
- Mesoamerica

## **Gulf of Mexico Initiative, GOMI (SSC)**

Building Gulf region's capacity for local environmental management



# NASA Earth Science Applied Sciences Program



## Applications to Decision Making: Thematic Areas



**Agricultural  
Efficiency**



**Air Quality**



**Climate**



**Disaster  
Management**



**Ecological  
Forecasting**



**Public Health**



**Water  
Resources**



**Weather**

## **GOAL:**

Increase utilization of NASA observational and model data for decision-support

## **Online and hands-on courses:**

- **Who:** policy makers, environmental managers, modelers and other professionals in the public and private sectors.
- **Where:** U.S and internationally
- **When:** throughout the year. Check websites.
- Do NOT require prior remote- sensing background.
- Presentations and hands-on guided computer exercises on how to access, interpret and use NASA satellite images for decision-support.



NASA Training for California Air Resources Board, Sacramento

# Gradual Learning Approach



## Basic Training

Webinars

Hands-on

Assumes no prior knowledge of RS



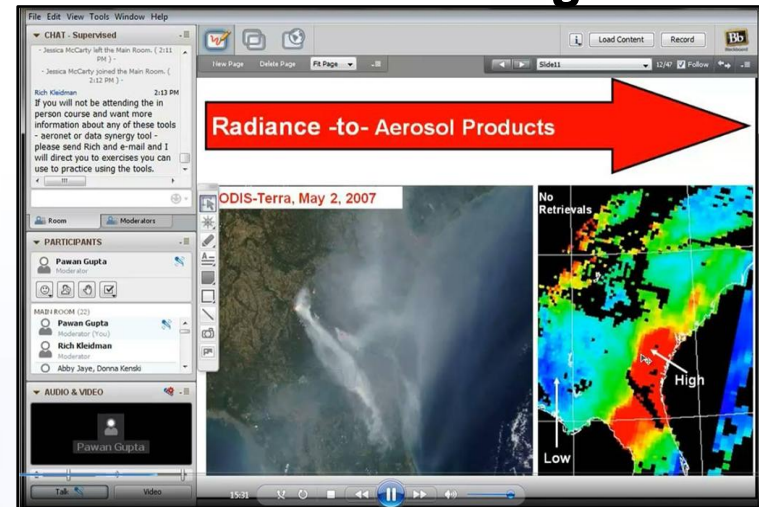
## Advanced Training

Hands-on

Webinar course generally required

Focused on a specific application/problem/Data: for example  
dust or smoke monitoring in a specific country or region

## Online Training



## In-Person Training



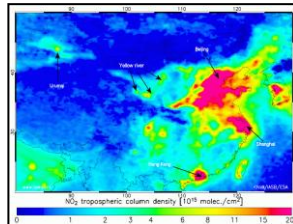


# Applied Remote Sensing Training Program (ARSET)

## Health & Air Quality

- 2008 – present
- 34 Trainings
- 1000+ end-users
- Analysis of dust, fires and urban air pollution.
- Long range transport of pollutants
- Satellite and regional air quality model inter-comparisons.
- Support for air quality forecasting and exceptional event analysis

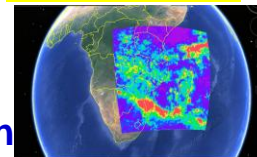
Nitrogen Dioxide over China



## Water Resources and Flood Monitoring

- April 2011 – present
- 9 Trainings
- 500+ end-users
- Flood/Drought monitoring
- Severe weather and precipitation
- Watershed management
- Climate impacts on water resources
- Snow/ice monitoring
- Evapotranspiration (ET), ground water, soil moisture, and runoff.

Satellite derived precipitation



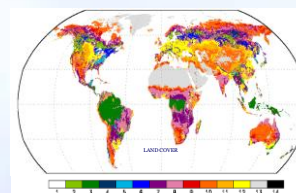
Inundation mapping



## Land Use/Change and Ecology

- First webinar just completed and in-person courses planned
- Focus on NGOs and Federal agencies
- GIS applications
- Land use/change and vegetation indices
- Fire products

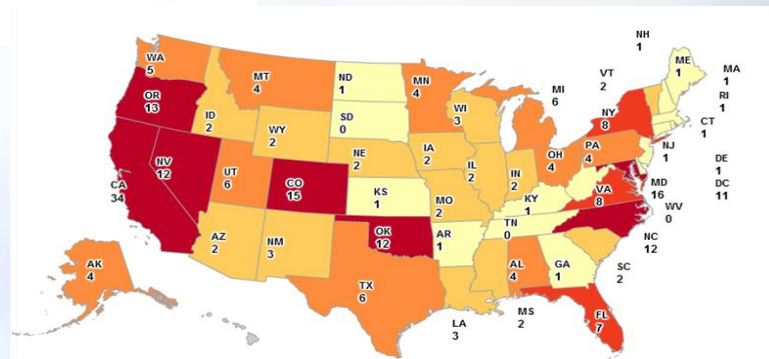
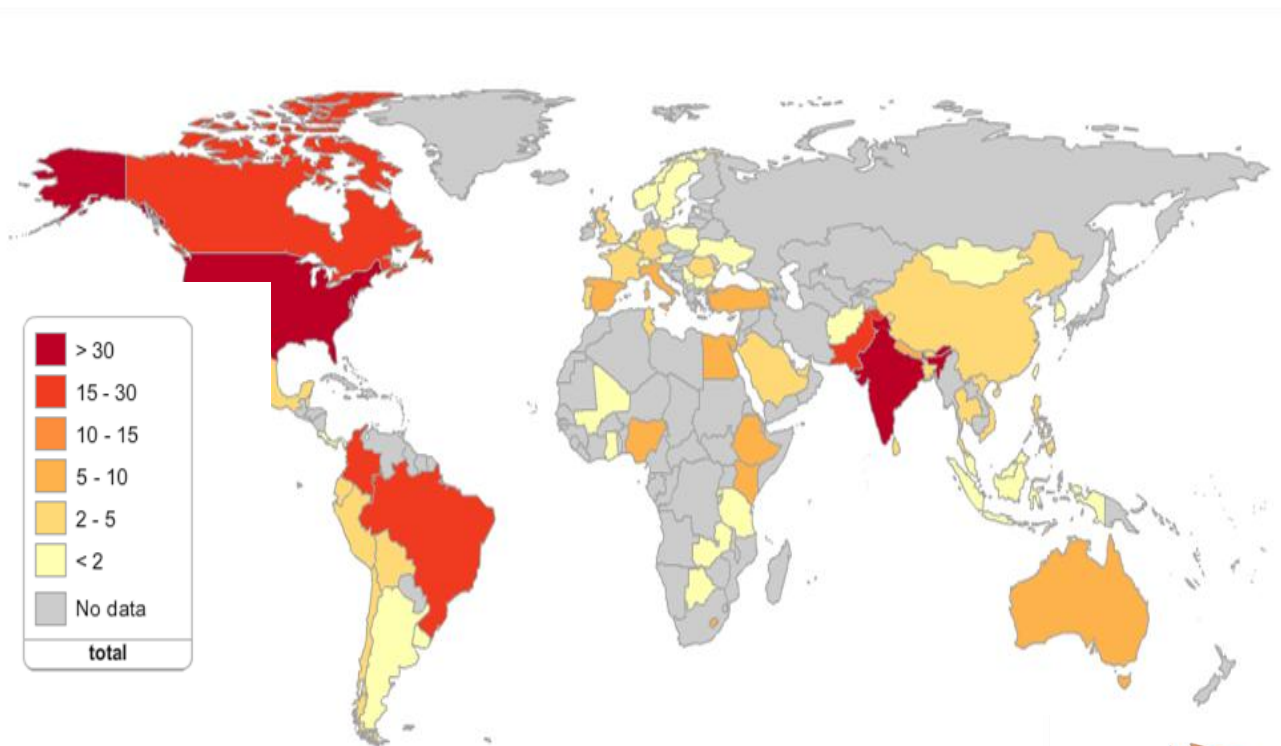
Land Cover



# ARSET: 2009 – 2013



**1500+ end-users reached**  
**552 organizations**





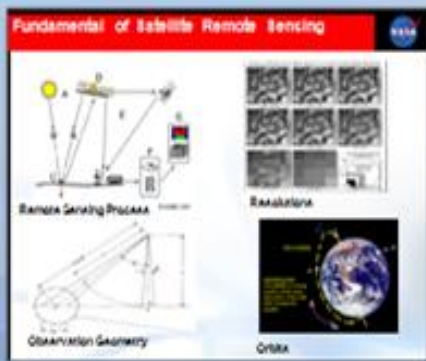


**What is covered in a typical ARSET  
Air Quality Training?**

**Or**

**How is ARSET using AURA data**

# Satellite Data & Applications



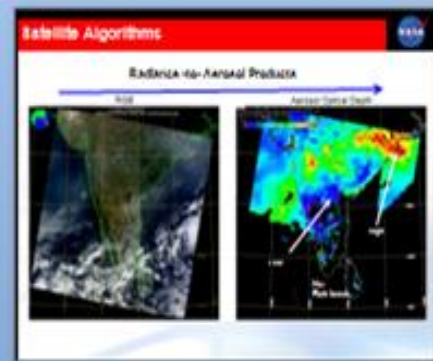
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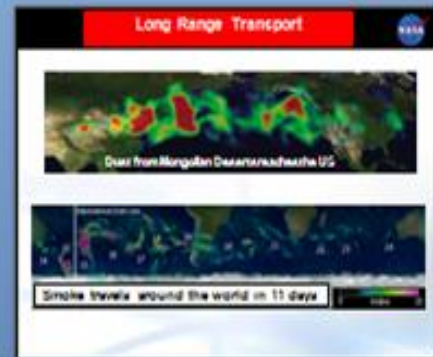
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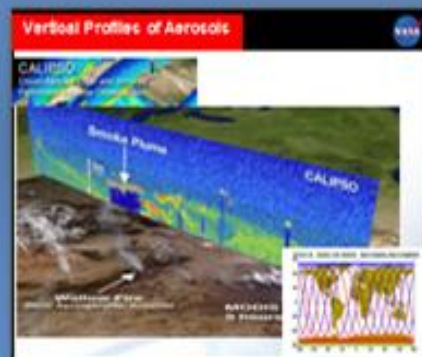
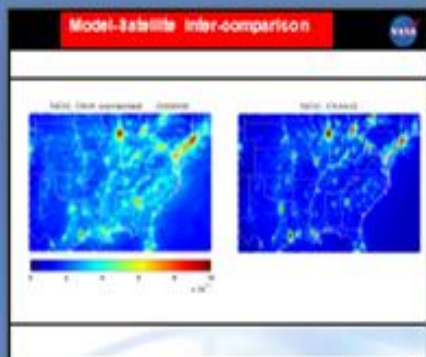
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- MODIS
- OMI
- CALIPSO
- MISR
- VIIRS
- TRMM

# Types of Training Modules



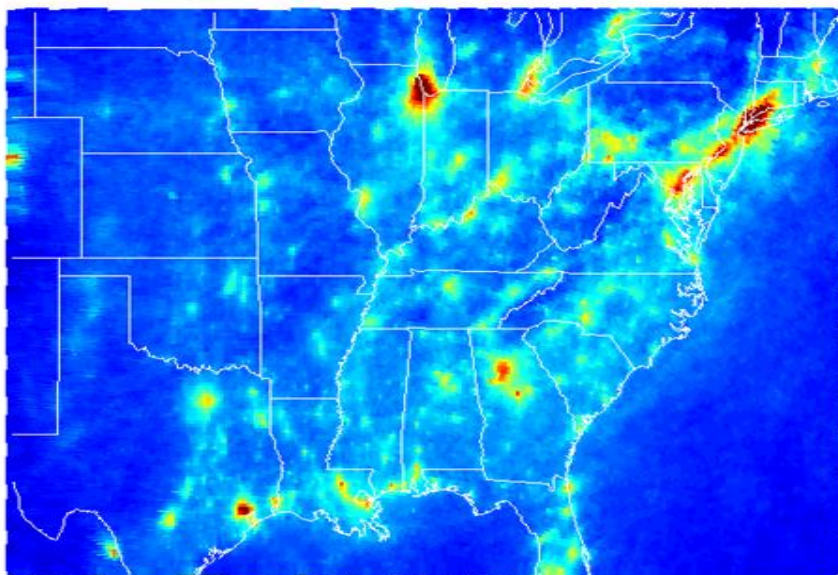
- **Trace Gas (OMI) imagery access and interpretation:**
  - Giovanni, MIRADOR
  - NASA AVDC
- **Case Studies in the application of Aura data for a specific area of interest, e.g. Texas (Spring 2014), LADCO region (Midwest, 2013), NESCAUM/MARAMA (Fall 2013), California Air Resources Board (2010, 2011)**
- **Benefits and limitations of Aura remote sensing products**



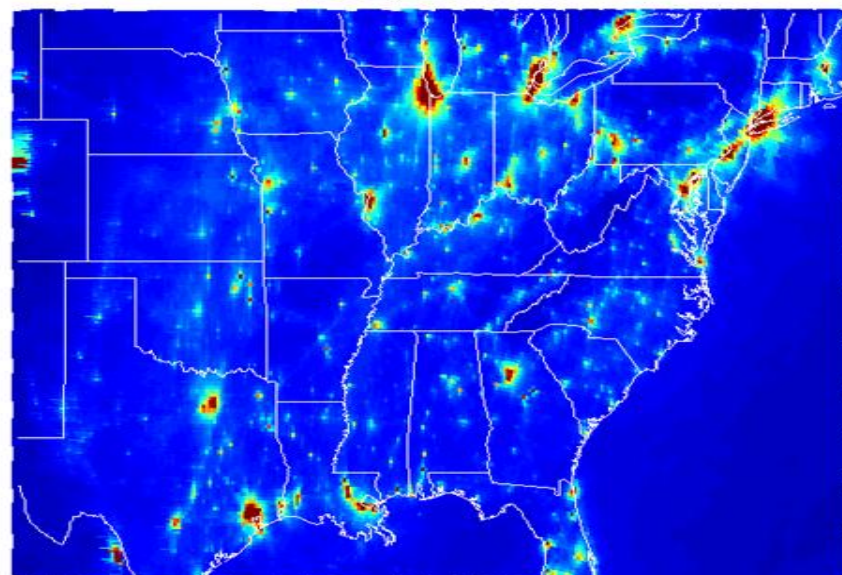
# Model-Satellite Inter-comparison:



OMI NO2

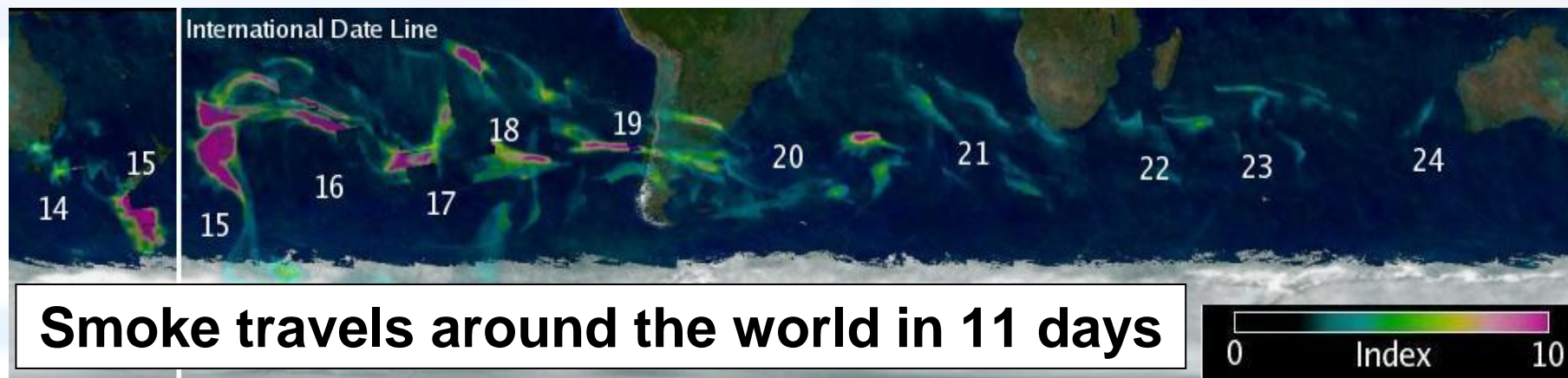
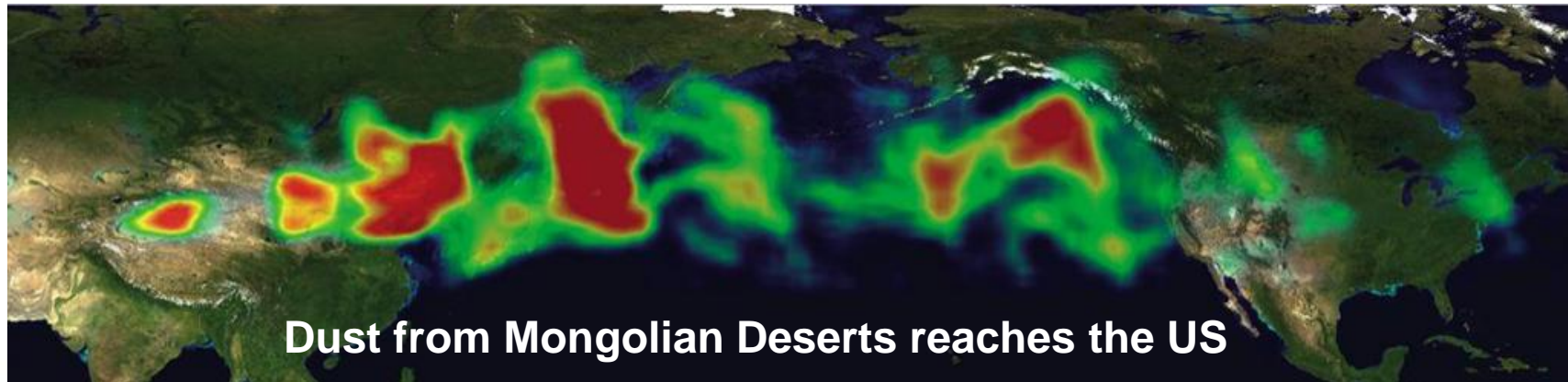


CMAQ NO2



- This application has been covered multiple times during ARSET trainings at the CMAS annual conference (2009 – 2013)
- **The RSIG EPA tool, which provided access to NASA and CMAQ data will be taught at a training at EPA RTP next week**

# Long Range Transport: Accessible via Worldview and Giovanni



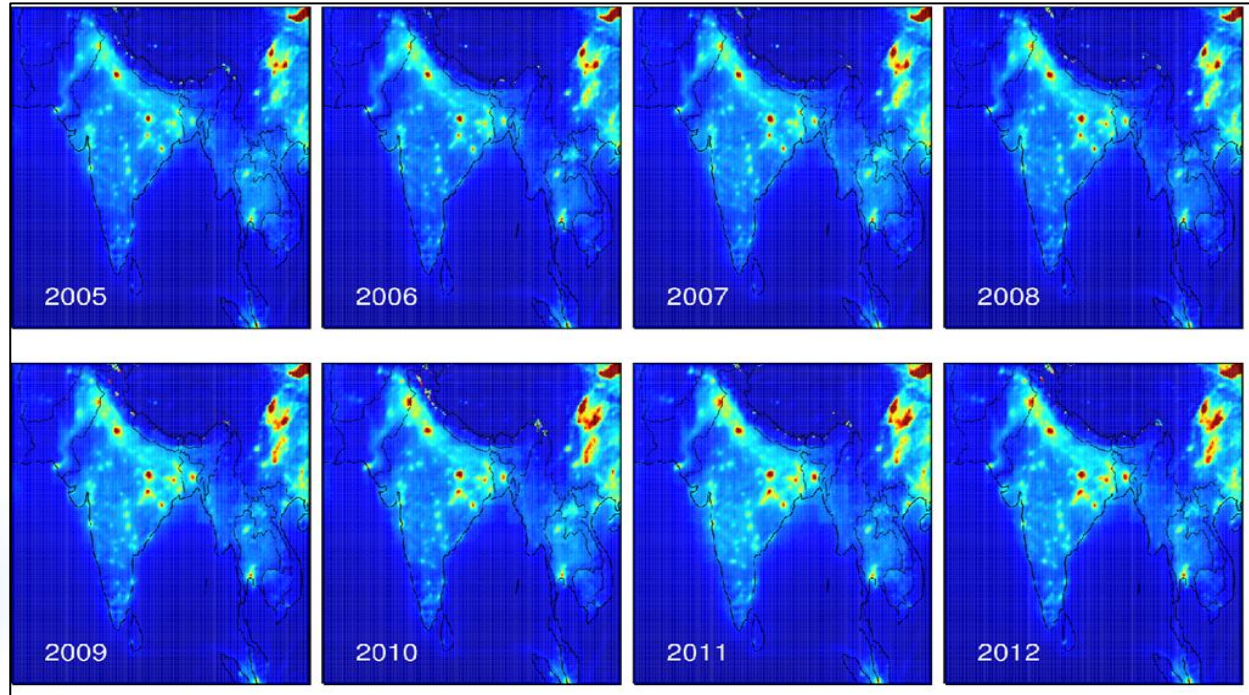
OMI Aerosol Index has been extensively used to track absorbing aerosols transport around the globe



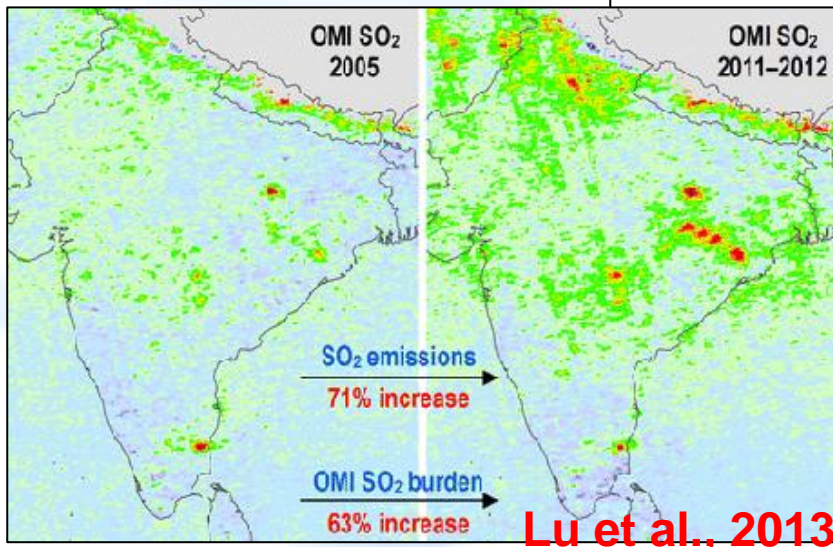
# Air Quality Trends: Webinar for the Indian Subcontinent, March 2014



## OMI NO<sub>2</sub> Trends



courtesy: Lok Lamsal



Lu et al., 2013

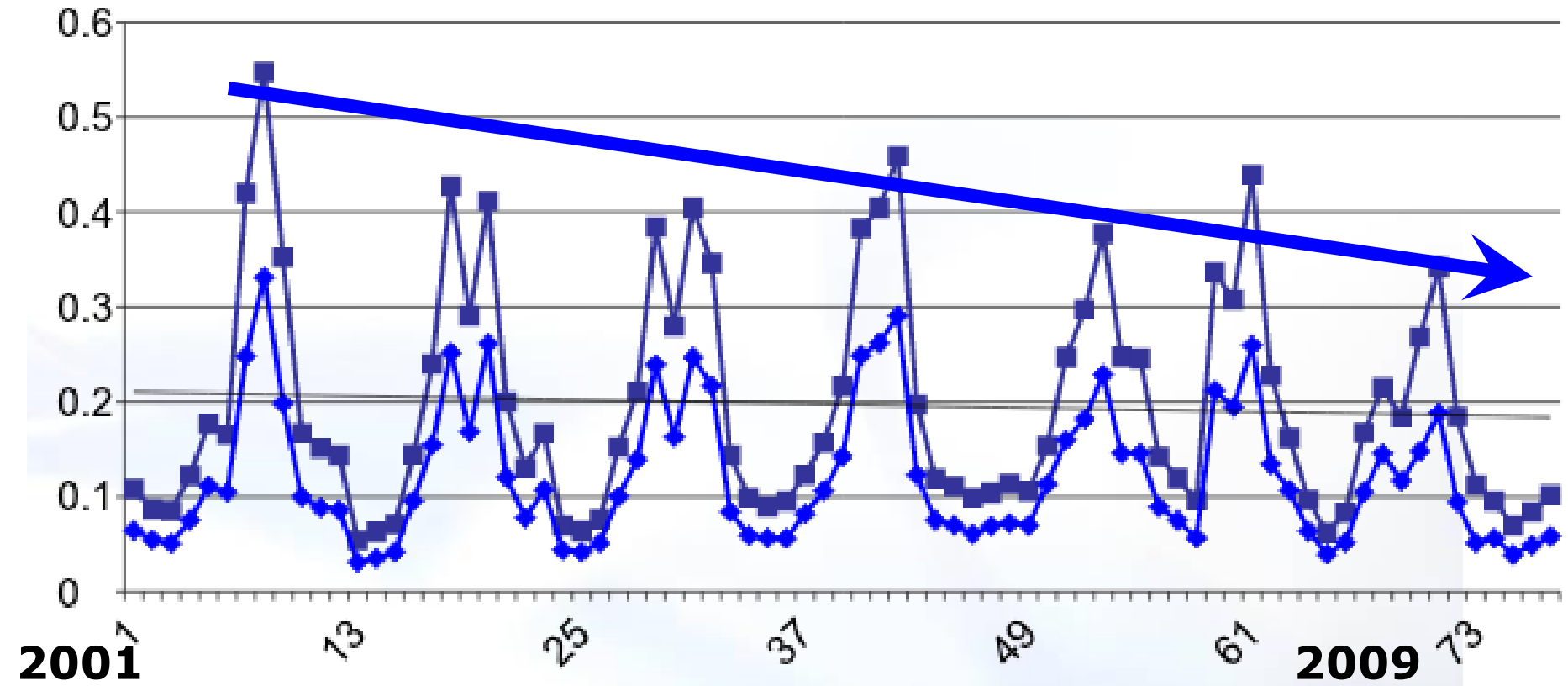


## OMI SO<sub>2</sub> Trends

Level 2G and Level 3 data access and analysis modules are developed based on NASA online GIOVANNI tool



# Air Quality Trends



- We provide examples of current or recent research applications
- Developed interactive exercises using Giovanni & L2 data for more advance users

# Data User Guide



**Bryan N. Duncan, Ana I. Prados**, Lok N. Lamsal, Yang Liu, David G. Streets, **Pawan Gupta**, Ernest Hilsenrath, Ralph A. Kahn, J. Eric Nielsen, Andreas J. Beyersdorf, Sharon P. Burton, Arlene M. Fiore, Jack Fishman, Daven K. Henze, Chris A. Hostetler, Nickolay A. Krotkov, Pius Lee, Meiyun Lin, Steven Pawson, Gabriele Pfister, Kenneth E. Pickering, R. Bradley Pierce, Yasuko Yoshida, Luke D. Ziemba, **Satellite data of atmospheric pollution for U.S. air quality applications: Examples of applications, summary of data end-user resources, answers to FAQs, and common mistakes to avoid**, Atmospheric Environment, Volume 94, September 2014, Pages 647-662, ISSN 1352-2310, <http://dx.doi.org/10.1016/j.atmosenv.2014.05.061>.

(<http://www.sciencedirect.com/science/article/pii/S1352231014004270>)

## An ARSET/AQAST Collaboration

**Training Modules in  
English and Spanish**

**Updates on upcoming  
workshops**

**Data Product Tables**

**Links to popular NASA  
web tools for decision  
support**



The screenshot shows the NASA ARSET (Applied Remote Sensing Training) website. The header features the NASA logo and the text "ARSET Applied Remote Sensing Training". Navigation links include "Earth Science Division", "Applied Sciences", and "ASP Water Resources". A search bar is located on the right. Below the header, there are four main categories: "DISASTERS", "ECO FORECASTING", "HEALTH & AIR QUALITY", and "WATER RESOURCES". The "ARSET" section is highlighted, showing a sidebar with links to "Webinars", "Workshops", "Personnel", and "Links". The main content area is titled "Applied Remote Sensing Training" and contains the following text:

The goal of the NASA Applied Remote Sensing Training (ARSET) is to increase the utility of NASA earth science and model data for policy makers, regulatory agencies, and other applied science professionals in the areas of Health and Air Quality, Water Resources, Eco Forecasting, and Disaster Management.

The two primary activities of this project are in-person courses and webinars.

**In-Person Courses**

ARSET in-person courses are a combination of lectures and computer hands-on activities that teach professionals how to access, interpret, and apply NASA data at regional and global scales with an emphasis on case studies. The program generally works with a host organization and other groups within their geographical region to tailor the curriculum and exercises to the needs of the projected attendees.

**Webinars**

Webinars are offered throughout the year in all four application areas and they usually last 4-5 weeks, 1 hour per week. They are intended for those new to remote sensing. For more information please go to the webinars section of the website.

**Skills Taught:**

- Search, access, and download of NASA data products and imagery
- Appropriate use and interpretation of satellite imagery.
- Visualization and analysis of NASA imagery using NASA, EPA, and NOAA webtools and other resources such as GIS, Google Earth, Panoply, RSIG, and HDFLook